Free-Swelling Index of Coal

Bureau of Mines Report of Investigations 3989 was revised.[20] This gives the results of a study of the American Society for Testing Materials Standard Method of Test for Free-Swelling Index of Coal, A. S. T. M. Designation: D 720 - 46. The report discusses some of the results obtained by the Bureau of Mines after the test was begun in 1938 and procedures to overcome difficulties with coals giving carbonized buttons whose shapes do not correspond with the standard profiles. It was concluded from the study that the test is valuable for obtaining information regarding the coking and caking properties of coal on fuel beds, but it should not be used as a measure of the amount of expansion or contraction that takes place during carbonization of coal in coke ovens and is not recommended for this purpose. A simple method for obtaining free-swelling indexes of coals whose shapes do not conform to any of the standard profiles is described, whereby the index can be obtained from a curve relating the cross-sectional areas of the buttons to the swelling-index numbers.

COAL MINING

Experimental Mine and Dust Explosions

Demonstrations

Educational demonstrations of the hazards of mine explosions and of means for preventing them were continued for the benefit of workers and officials of the coal-mining industry, for mining students, and for others. Of five public demonstrations at the Experimental coal mine, attended by more than 600 people, one was held for the benefit of the Technical Committee of the National Fire Protection Association and another for the American Institute of Electrical Engineers.

A routine demonstration of methods of extinguishing mine fires was given at the Experimental coal mine for the benefit of coal-mine officials, fire bosses, and foremen to show the efficacy of water containing a wetting agent on a standard floor, rib, roof fire developed by the Bureau. It was attended by about 250 people.

Technical Assistance and Services to Others

Based on experiments in the laboratory, data were furnished the National Fire Protection Association on the limiting percentage of oxygen in the atmosphere to prevent explosion of carbonaceous dusts. The National Fire Protection Association also was assisted in revising the tentative code for explosion pressure release.

Preventing Propagation of Coal-Dust Explosions in Mine Rooms

As a result of certain requirements for rock-dusting coal mines promulgated in the Federal Mine Safety Code for Bituminous-Coal and Lignite Mines of the United States, July 24, 1946, an investigation was conducted in the Experimental coal mine, at the request of the Coal Mines Administration.[21] The objectives were to determine

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20/ Selvig, W. A., and Ode, W. H., An Investigation of a Laboratory Test for Determination of the Free-Swelling Index of Coal: Bureau of Mines Rept. of Investigations 4238, 1948, 11 pp.

21/ Howarth, H. C., Nagy, John, Hartmann, Irving, Greenwald, H. P., and Lewis, Bernard, Tests in the Experimental Coal Mine to Determine Requirements for Preventing Propagation of Coal Dust Explosions in Rooms: Bureau of Mines Rept. of Investigations 4195, 1948, 12 pp.

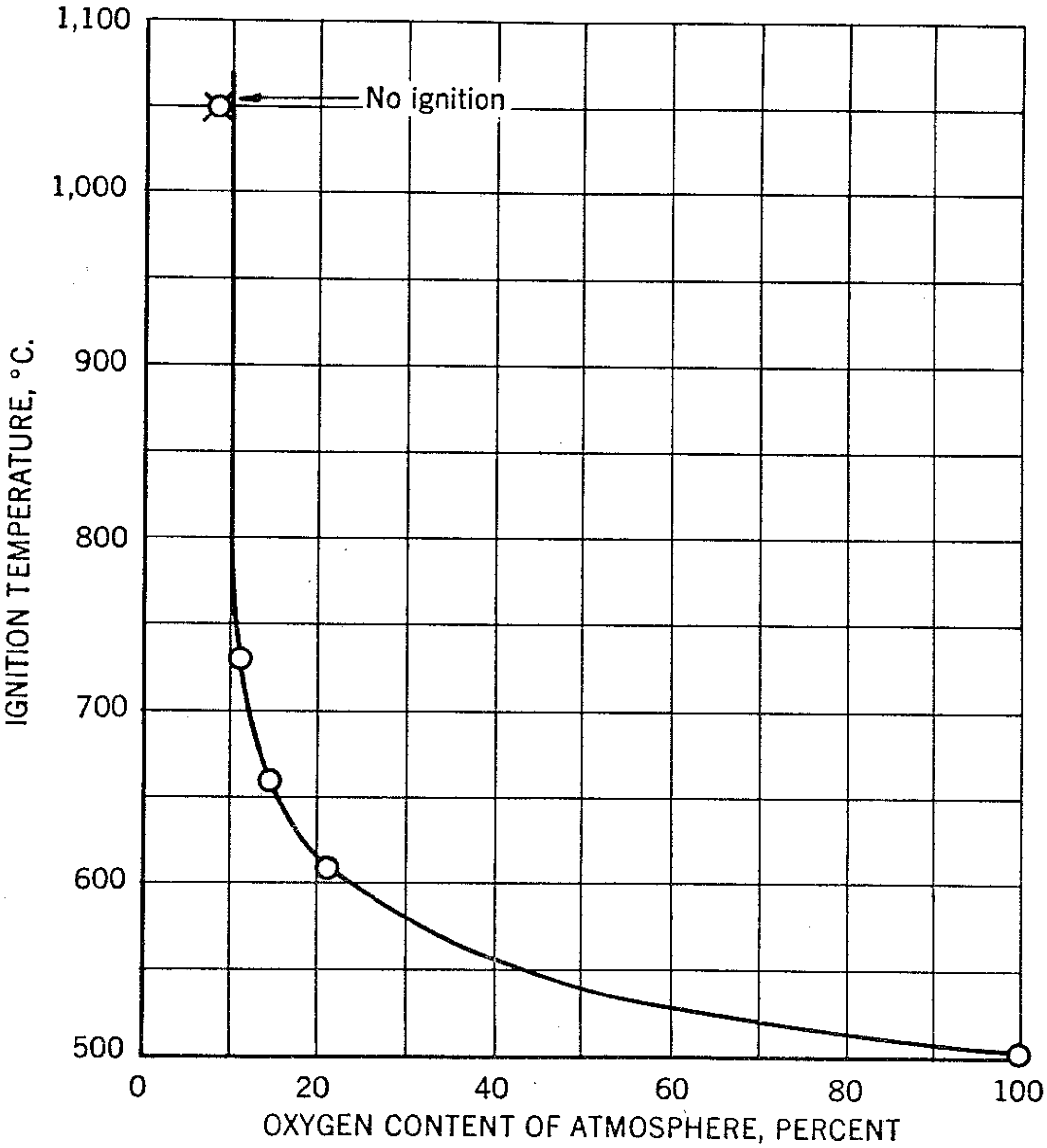

Figure 8. - Effect of oxygen content of atmosphere on the ignition temperature of dust clouds of minus 200-mesh Pittsburgh coal.

how rock-dusting requirements in short, wide rooms compare with those in long, narrow entries; the effect of crosscuts between rooms; and whether bag-type devices,[22] or modifications thereof now in use, are effective in preventing propagation of an explosion from a room into adjacent rooms and into the entry from which the room is turned.

The investigation led to the following conclusions:

1. Propagation of coal-dust explosions originating in single, narrow or wide, coal-mine rooms or workings of relatively short length can be prevented by generalized rock dusting carried up to within 40 feet of the working face if the incombustible content of the dust is maintained above 65 percent. Rock dust carried up to within only 80 feet of the working face will not prevent propagation of coal-dust explosions in such workings.

2. To prevent the propagation of coal-dust explosions in wide, connecting workings or rooms, a minimum of 65 percent incombustible material in the dust must be maintained up to within 40 feet or less of the working face.

3. Bag-type rock-dust protective devices tested thus far are ineffective in preventing the propagation of explosions either between connected rooms or from rooms into entries. The chief cause of failure of these devices is that the rock dust is not adequately dispersed into the air stream at the proper moment. The arrangements that were tested were those that could be installed readily in commercial mines. They leave the trackway in rooms unprotected. To be effective, any improved form of these devices must have more positive means of operation, so as to disperse efficiently at least 70 percent of the rock dust at the proper moment, and be capable of installation over track or other haulageways so that the entire width of the room is protected.

Effect of Oxygen Content of the Atmosphere on Ignition Temperature of Coal Dust

The composition of the atmosphere, particularly its oxygen content, has profound effects on the initiation and development of dust explosions. Experiments have shown[23] that, as the oxygen content of the atmosphere is reduced, the ignition temperature of dust clouds is increased. This is illustrated for fine Pittsburgh coal dust in oxygen, in air, and in mixtures of air and carbon dioxide (fig. 8). Other experiments have shown that reduction of the oxygen content by dilution of air with carbon dioxide or nitrogen reduces the relative inflammability of dust clouds.

Coal Investigations

Toledo, Lewis County, Wash.

The results of an investigation of a lignite deposit near Toledo, Lewis County, Wash., were published.[24] The center of the area is approximately 9 miles west of

[22] Greenwald, H. P., and Howarth, H. C., Tests of a Barrier Using Rock Dust in Paper Bags: Bureau of Mines Rept. of Investigations 3411, 1948, 16 pp.
[23] Hartmann, Irving, Recent Researches on the Explosibility of Dust Dispersions: Ind. Eng. Chem., vol. 40, No. 4, April 1948, pp. 752-758.
[24] Toenges, Albert L., Turnbull, Louis A., and Cole, Willard A., Exploration, Reserves, Bed Characteristics and Strip Mining Possibilities of a Lignite Deposit near Toledo, Lewis County, Wash.: Bureau of Mines Tech. Paper 699, 1947, 55 pp.

Toledo, Wash. (see fig. 9) and approximately midway between Tacoma, Wash., and Portland, Oreg. Thirty-five diamond-drill holes were put down, and these determined the extent of the deposit and the limit of the area favorable for strip mining (see fig. 10).

An area of lignite approximately 4,750 feet long, northwest-southeast, and a maximum of 1,700 feet wide, northeast-southwest, which can be mined by stripping methods, was delineated by the investigation. The estimated proved reserve of lignite in the lens is 8,031,000 tons, assuming that both the upper and lower benches of the lignite lens will be mined. Of this, 5,317,000 tons, under a maximum overburden of 65 feet, are considered minable by stripping methods. The area of the strippable tonnage is estimated at 142.5 acres. The average thickness of overburden in this area is 42 feet, and the stripping ratio is 1.7 cubic yards of overburden plus first main parting per ton of recoverable lignite.

A method of operation considered adaptable to this deposit would be to strip off the overburden with a medium-size power shovel and transport the spoil in trucks for disposal beyond the limits of the lignite lens, or by using tractor-scraper units to both excavate and transport the overburden. This method has advantages over the use of large power shovels or draglines and overcasting, because of the topography, the characteristics of the overburden, the wet winter months, and the occurrence of the lignite in two minable benches separated by a thick parting. The mining of the upper bench of lignite, the removal of the first main parting, and the mining of the lower bench of the lens should be so planned that production of lignite from the two benches is balanced.

Coos Bay, Oreg.

Some of the fuel requirements of the Pacific Northwest are met from the Coos Bay coal field. The results of an investigation to determine the minable reserves in a portion of the coal field were published.[25] The area investigated was approximately 6 miles long, north and south, and extended from 4 miles south of Coos Bay, formerly Marshfield, Oreg., to the Old Beaver Hill mine (see fig. 11).

The drilling and surface excavations (see fig. 12) show that the Beaver Hill bed is the most important coal bed in the area. The bed comprises 3 benches of subbituminous B coal separated by partings. The upper bench is the thinnest and is usually left for mine roof. The middle and lower benches usually are recovered in mining.

Diamond drilling proved 1,020 acres of land in the area to be underlain by Beaver Hill coal. In addition to this proved area, there are 142 acres of indicated and 435 acres of inferred reserves of Beaver Hill coal.

25/ Toenges, Albert L., Dowd, James J., Turnbull, Louis A., Schopf, J. M., Cooper, H. M., Abernethy, R. F., Yancey, H. F., and Geer, M. R., Minable Reserves, Petrography, Chemical Characteristics and Washability Tests of Coal Occurring in the Coos Bay Coal Field, Coos County, Oreg.: Bureau of Mines Tech. Paper 707, 1948, 56 pp.

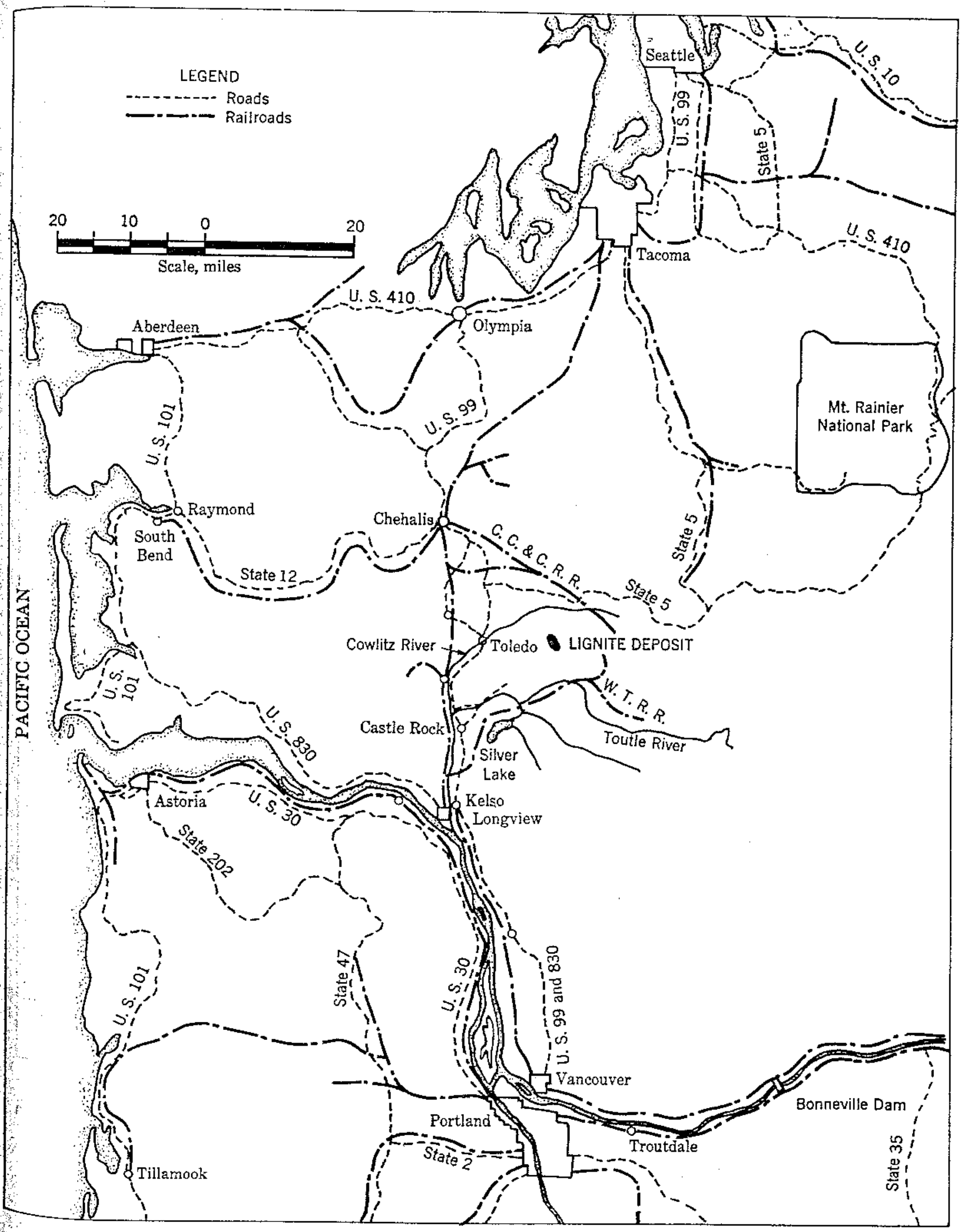

Figure 9. - Location of Toledo, Wash., lignite deposit.

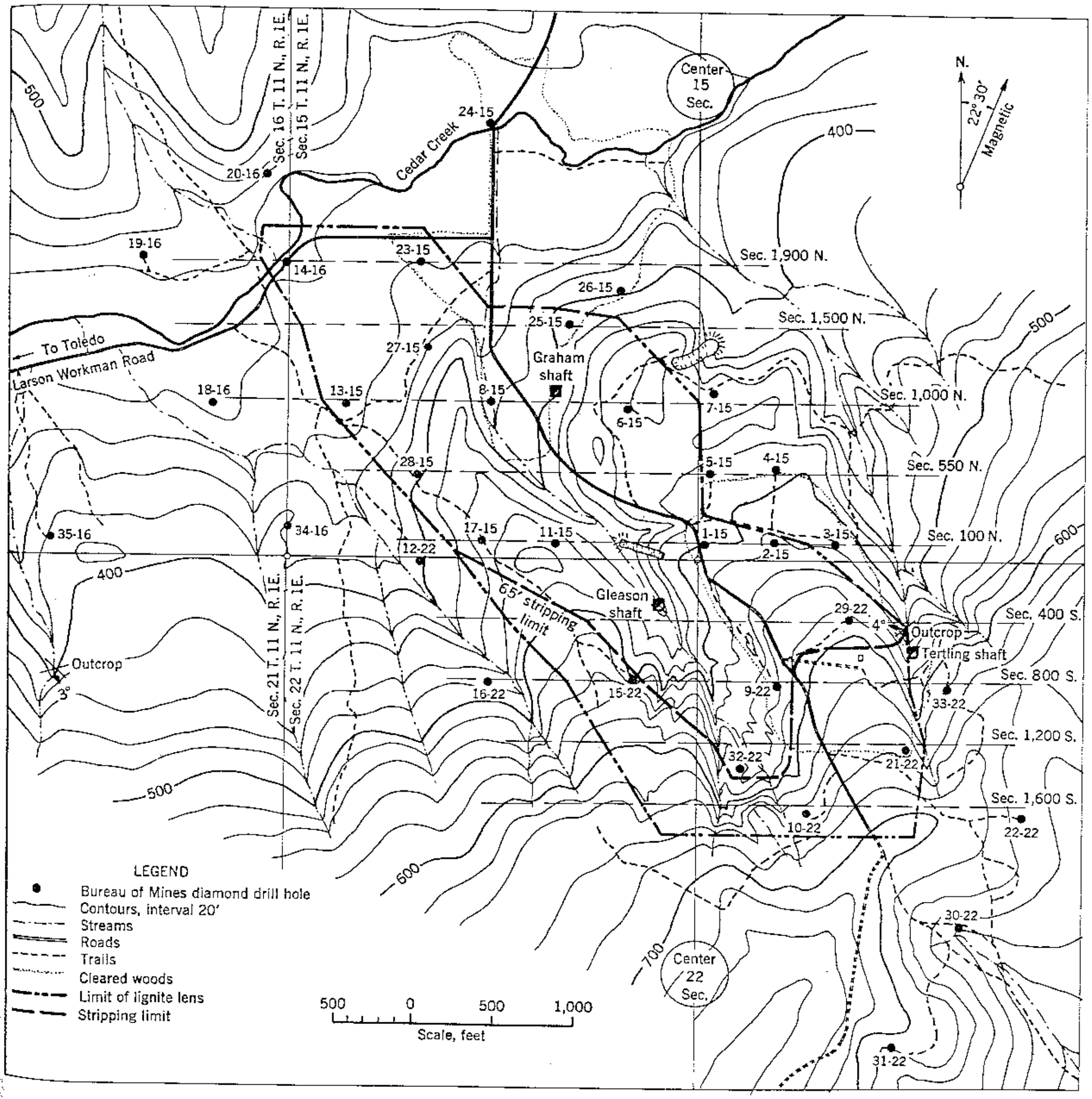

Figure 10. - Exploration secs. 15, 16, 21, and 22, T. 11 N., R. 1 E., near Toledo, Lewis County, Wash. (Prepared from map compiled by Geology of Fuels Section, U. S. Geological Survey.)

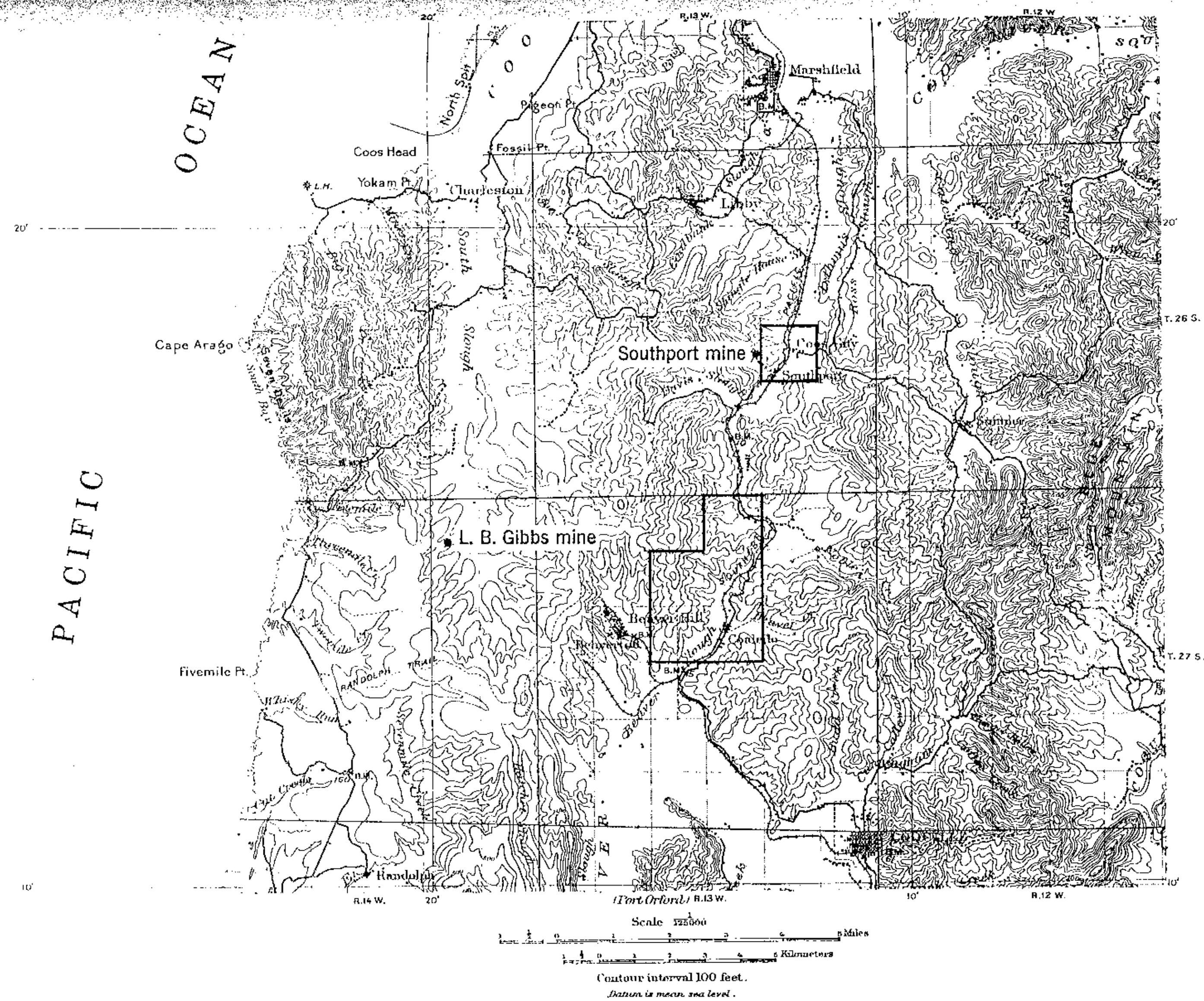

Figure 11. - Topographic map of region. Part of Coos Bay, Oreg., quadrangle. (U. S. Geological Survey.)

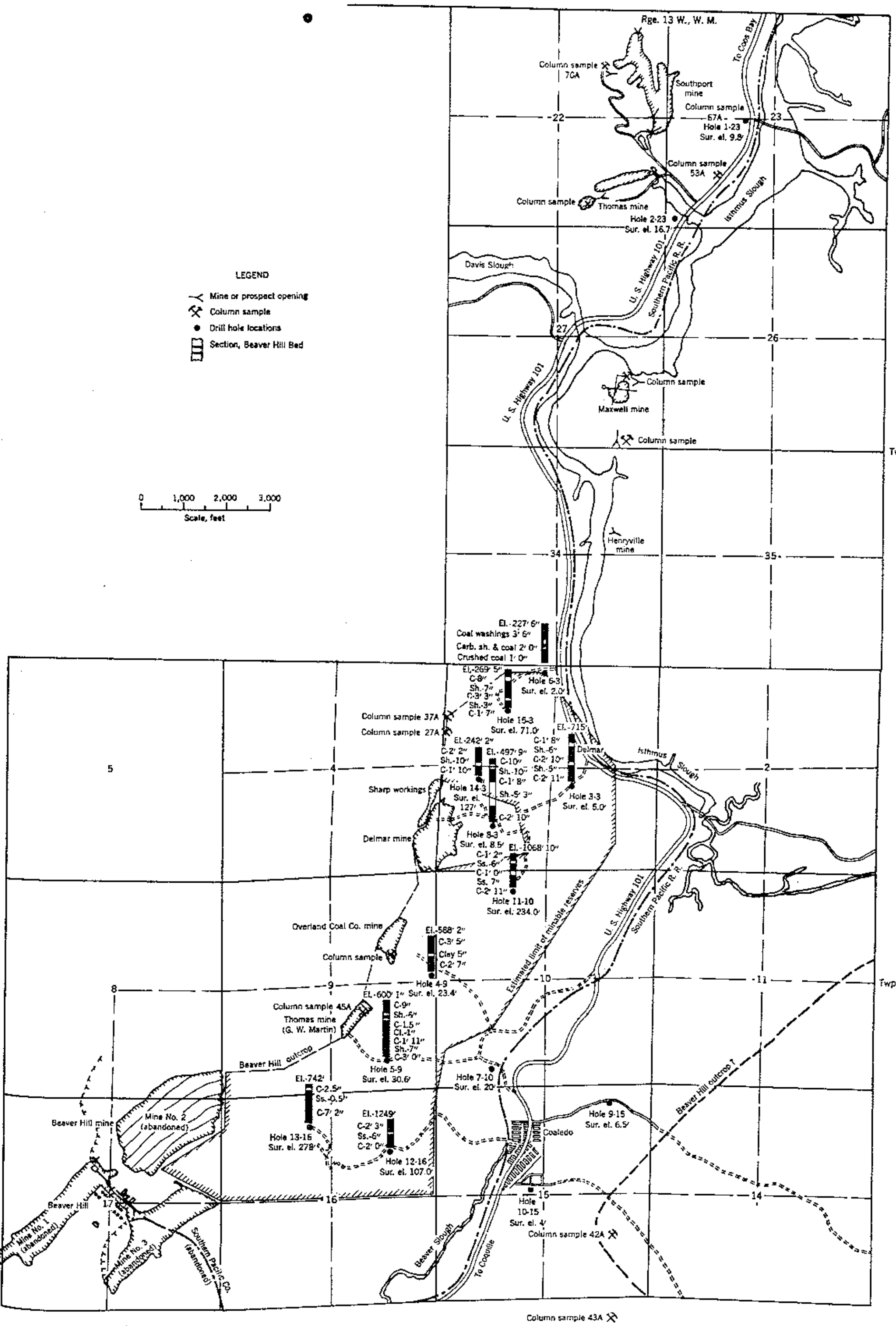

Figure 12. - Diamond drilling in Beaver Hill coal bed, Tps. 26 and 27, R. 13 W., Coos County, Oreg.

Proved, indicated, and inferred reserves were summarized as follows:

TABLE 3. - Summary of proved, indicated, and inferred reserves

	Average thickness of bed		Acres	Total reserves, tons
	Ft.	In.		
Proven	6	5	1,020	10,809,900
Indicated	6	8	142	1,646,600
Inferred	6	0	435	4,546,600
			1,597	17,003,100

The minable reserves are estimated at 13,602,000 tons, based on 80 percent recovery of the coal in the area.

Washability tests, made on coal from two mines near the area investigated, in-
dicate that the coal can be washed successfully. Samples of the Beaver Hill coal
used in the washability tests included all of the partings in the bed. Results of
these tests show that about 80 percent of the raw coal can be recovered in washing,
reasonable recovery and that the ash content of this washed coal will be about 10
or 11 percent, eliminating practically all of the parting material. The coal can
be mined mechanically.

Meta-Anthracite in Newport and Providence Counties, R. I.

The fuel requirements for industrial and domestic consumers in New England are supplied almost entirely by fuel oil, anthracite, and bituminous coal. Shortages of these fuels led to an investigation of possible sources of fuel nearer to points of consumption in New England.

Meta-anthracite, which is a satisfactory fuel for some purposes, had been
mined in Massachusetts and Rhode Island many years ago. The coal from mines in the
vicinity of Portsmouth on Aquidneck Island, Newport County, R. I., had been used
successfully for smelting copper ore and for fuel. The introduction of freer-burning
anthracite and bituminous coal into New England markets resulted in abandonment of
these mines. With the present-day development of improved equipment for burning coal,
methods of burning it probably could be devised, should minable reserves of coal be
found. Diamond drilling was undertaken to determine the characteristics and continu-
ity of the beds in the Portsmouth area.[26]

Three vertical diamond-drill holes to recover 2-1/8-inch cores were drilled from surface locations on the north end of Aquidneck Island in the town of Portsmouth. The Cranston mine, of Graphite Mines, Inc., also was examined.

The results of the investigation of the Portsmouth and Cranston areas are summarized as follows:

1. Investigation by diamond drilling and geological examination in the Portsmouth area on Aquidneck Island indicates that minable beds of meta-anthracite

[26] Toenges, Albert L., Turnbull, Louis A., Neale, Arthur, Schopf, J. M., Abernethy, R. F., and Quinn, Alonzo W., Investigation of Meta-Anthracite in Newport and Providence Counties, R. I., Petrography, Chemical Characteristics, and Geology of Deposits: Bureau of Mines Rept. of Investigations 4276, 1948, 37 pp.

are not continuous over appreciable areas, and no estimate can be made of possible reserves in this vicinity.

2. The exposed faces in the workings of the Cranston mine of Graphite Mines, Inc., indicate that there is a recoverable reserve of meta-anthracite adjacent to the workings of this mine. The recoverable reserves cannot be estimated, because the structure and thickness of the bed may change sharply in any direction. The bed may "pinch" out or may be dislocated by faulting.

3. Petrographic examination of cores and mine samples shows that most of the coal of the Narragansett Basin has been subjected to intensive minor faulting and brecciation.

4. The dry ash ranges from 76.1 to 93.7 percent and total carbon from 1.8 to 19.5 percent. With a single exception, the analyses of the cores compared with analyses of meta-anthracite from Cranston and Portsmouth mines showed that the other cores cannot be classified as coal.

Coal Creek, Gunnison County, Colo.

The investigation of coking-coal reserves in this area by diamond drilling was continued and will be completed early in the fiscal year 1949. A diamond-drill hole to secure minimum 8-inch coal cores for carbonization tests is being drilled.

Castleman Basin, Md.

Diamond drilling at this project was in progress at the end of the fiscal year. To date, 21 holes (15,000 feet) have been drilled. Eleven coal beds are present in the area. However, the Lower Bakerstown, Upper Freeport, and Upper Kittanning beds appear, from the investigation thus far, to offer the best conditions for future development. The work will be completed in the fiscal year 1949.

Deep River, N. C.

Drilling difficulties, occasioned by caving ground at depth, has retarded the progress of the work on this project. It has been necessary to redrill three times. The third hole reached a depth of 2,167 feet at the end of the fiscal year. The Cumnock coal bed is anticipated at a depth of 2,300 feet. The investigation of this part of the coal field will be completed early in the fiscal year 1949.

Eska Creek, Matanuska Valley, Alaska

Work on this project was begun at the beginning of the fiscal year and recessed in October 1947 because of extreme weather conditions. Drilling was begun again in May 1948. Seven diamond-drill holes (4,000 feet) completed to date show that the coal beds mined at the Eska mine are not continuous at minable thickness in this area. Work at this project will be completed early in the fiscal year 1949.

Mining Methods and Practices

At the request of the Division of Geology, Arkansas Resources and Development Commission and the Arkansas-Oklahoma Coal Operators Association, a preliminary study of mining methods and practices in western Arkansas was made, with the objective of suggesting ways of reducing cost of mining.

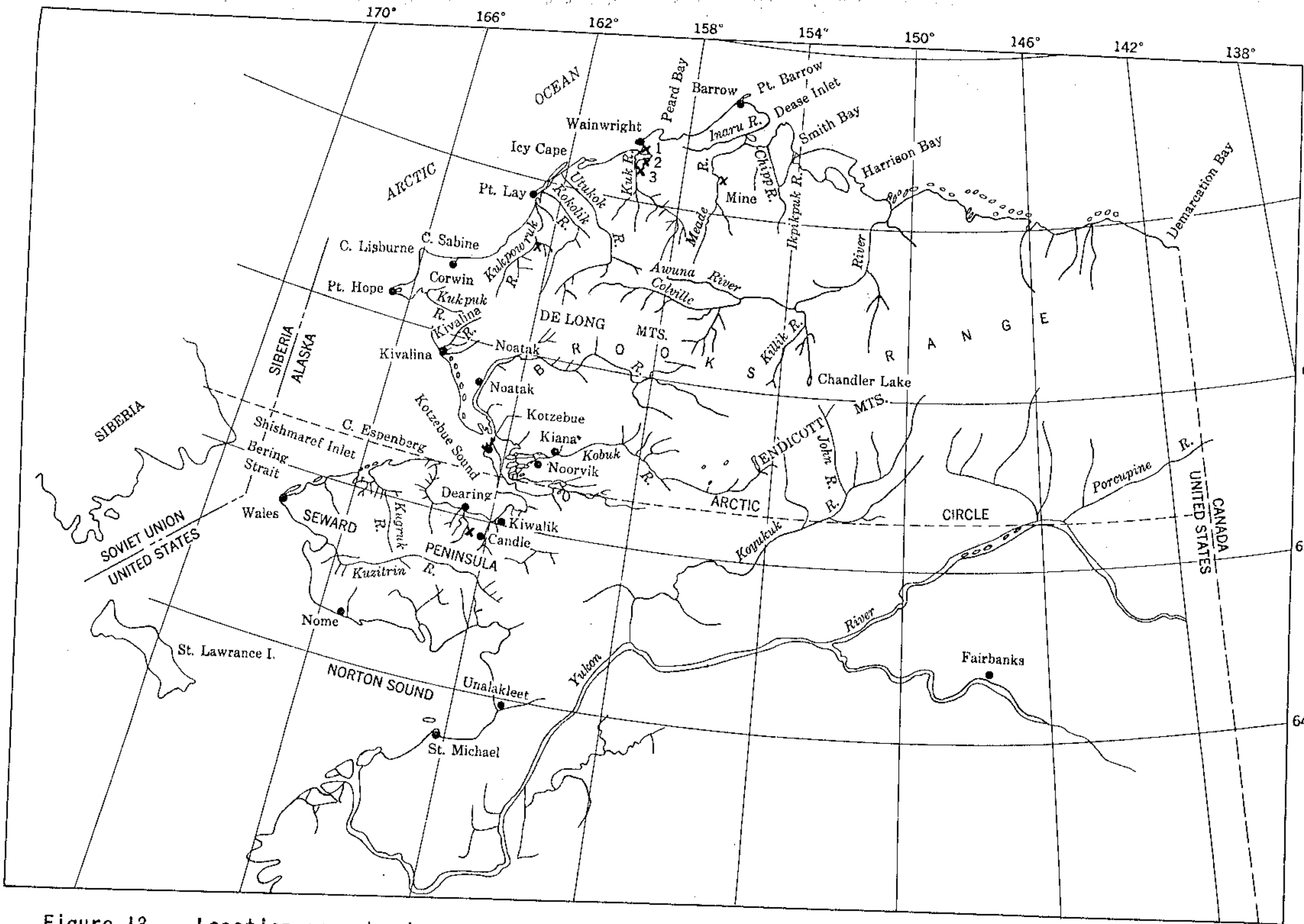

Figure 13. - Location map showing areas investigated (marked by x) in the Arctic regions of Alaska.